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Foreword

At the time of writing these lines, by a very unfortunate coincidence, most news agents are reporting that the Greater Horn of Africa has been hit by one of the most severe droughts in many years, leaving at least 10 million people in the region – including Somalia, Kenya, Ethiopia and the newly formed Republic of South Sudan – in desperate need of food, water and emergency healthcare. In parts of Somalia, the crisis has reached famine proportions. In the media, shocking articles and pictures describe an unbelievable situation of acute malnutrition and starvation. Food relief will arrive sooner or later and the dry agricultural fields and pastures will hopefully recover to some degree in the next rains. Is that going to be the end of the drought problem of many countries? Is that all we can do in the 21st century?

Similar events are recurring regularly. One memorable example is the famine in 1984-85 when 1 million people from Somalia and Sudan died. Other severe droughts followed this all over the world. Besides the post-factum humanitarian help, from a technical-scientific point of view, not much has been achieved in the course of trying to find a more permanent solution for drought management, or at least turn the negative trends back. The stress on water and land resources has been continuously increasing, mainly due to growing population and growing demand. As a consequence, the impact of drought has been exacerbated by other pressures. It is true that some studies have been prepared and some recommendations have been given to governments on drought management, but the scientific community is yet to come up with a systematic frame of understanding, monitoring and predicting drought to support more efficient drought mitigation efforts. Satellite observations have opened a whole new range of opportunities for a better understanding of the earth's climate and monitoring drought-creating factors but, , the first studies on how to use these tools for drought management have only recently been completed.

The present methodology is one of the first steps in a hopefully long series of new developments aimed at a better scientific understanding of drought and supporting its management. This publication, besides describing and demonstrating the theory behind the methodology, also presents an easy-to use software on the attached CD-ROM for calculating the CDI.

I trust that this publication will provide solid support to all interested policy-makers, stakeholders, partners and field practitioners in the development of appropriate strategies for drought monitoring and management.

Michele Bernardi
Senior Natural Resources Officer,
FAO



Part 1

Methodology



1.1 What is drought?

Drought is a natural phenomenon, a period during which unfavorable weather conditions persist, leading to scarcity of fresh water. Although drought is one of the most frequently used terms in African humanitarian actions, it is one of the least clearly understood terms from a scientific point of view. It is often used to explain various crises such as food shortages, crop or animal disease, armed conflicts, market problems, or just aridity. The impacts of drought are often similar to the impacts of other problems (e.g. land degradation, overgrazing), therefore proper attention should be paid to identifying the real causes of the problem. Due to an incorrect diagnosis, the management of drought could lack effectiveness. Based on literature review and other analysis our definition of drought is as below.

Drought is an extended period during which fresh water availability and accessibility in a given ecosystem at a given time and place is below normal, due to unfavorable spatial and temporal distribution of rainfall, temperature, soil moisture and wind characteristics. It is important to note that besides shortage of rainfall amounts, other natural factors too can contribute to the development of drought. These are:

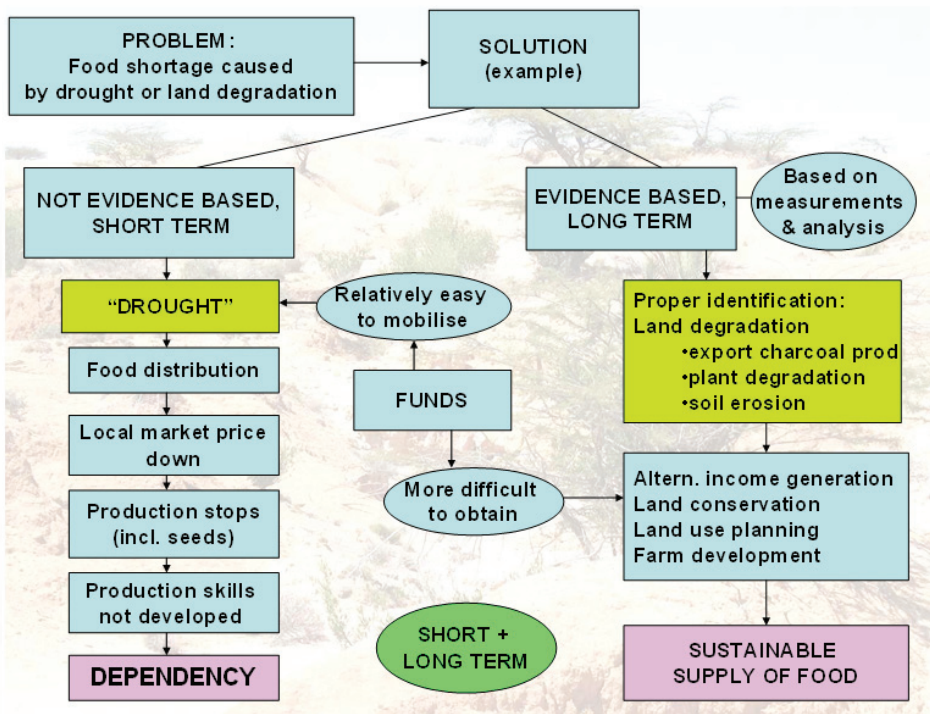
- Uneven temporal distribution of rainfall with long, below-average periods
- High temperatures and prolonged, above-average hot periods
- Low soil moisture content and uneven temporal distribution of soil moisture
- High velocity wind with extended duration

In the Horn of Africa at present it is only possible to monitor rainfall, air temperature and soil moisture; wind data are not available in adequate lengths of observation periods.

1.2 Why monitor drought?

Drought management requires evidence-based decisions. Evidence-based decisions should come from objective assessments, which require reliable information. Reliable information can be best obtained from adequately processed data generated from a well designed monitoring system. Uninformed, superficially drawn conclusions can lead to inappropriate or partial solutions. An example of the above decision-making process is given in Figure on page 6.

In this scenario, the problem is food shortage. It has been hot, the rains are patchy, and the production outlook is below average. This superficial analysis leads to the determination of drought as the cause of the food shortage, and the intervention called for is food distribution. However, in case the real cause of the food shortage is not natural drought but land degradation, the above intervention can in the long run even aggravate the problem instead of alleviating it; it can create unnecessary dependency. If the primary cause of the land degradation is extensive charcoal production resulting in plant degradation and soil erosion, an effective solution lies somewhere in alternative income generation, land conservation, farm development or similar projects. Note that short and long-term solutions often need to complement each other. In any case, without proper monitoring, it is difficult to identify the real causes of the problem and decide on the most appropriate solution.



Identification of the causes of food shortage

1.3 How to measure the severity of drought

Two groups of drought monitoring methodologies exist in the professional literature at present.

- a.) Indices based on water balance calculation.
- b.) Statistical indices based on time series analysis.

The water balance methodology requires application of several climatic and physical variables at a given time and space with the final goal being to determine the water deficit of the crop. Examples of these types of indices include the Palmer Drought Severity Index (PDSI), the Palmer Hydrological Drought Index (PHDI), the Palmer Z-index (PZI), the Crop Moisture Index (CMI), the Surface Water Supply Index (SWSI) and the Reclamation Drought Index (RDI).

Most statistical indices are based on one or occasionally seldom two parameters, mostly rainfall and sometimes temperature. To date, the most commonly used drought indices in this category include the Percent Normal Drought Index (PNDI), the Standardized Precipitation Index (SPI), the Precipitation Decile Index and the Weighted Anomaly Standardized Precipitation (WASP).

All of these indices were thoroughly analyzed for application in practical monitoring of drought in the Horn of Africa. The results led to the conclusion that there was a need to develop a new statistical drought index, one that is applicable in data-scarce environments and considers as many drought attributes as possible, and which can be easily adapted to various monitoring purposes.

1.4 Why is a new drought index needed?

Drought events are increasing, at least in Africa, and there is naturally more and more discussion about their mitigation and management. At the same time, the existing drought indices do not meet the special requirements of African drought managers. The water balance methods are far too complex and require a large number and many types of data that are simply not available. The statistical indices 1) do not fully comply with the fundamental requirements of the definition of drought, because they mostly consider only one or two parameters; 2) do not consider the persistence of the stress periods, and 3) require continuous data observation without gaps. In the absence of easy-to-use monitoring tools and methodologies, often rudimentary methodologies are used, like the annual rainfall amount. As even a few months, sometimes a few weeks of unfavorable climate conditions cannot be well tolerated by the plants, it is obvious that shorter period drought analysis is needed, which should also offer the possibility to be extended to annual or even longer periods.

The CDI incorporates and reflects the combined effect of the six drought-creating parameters listed in 1.5.1 and offers the following features:

- It can be based on 10-day or monthly observations and cover seasonal, annual or longer periods
- It can be used in data-scarce environments, with data gaps in the observed series
- It gives the flexibility to change the time units (interest periods) and lengths of analysis to fit various geographic areas and climate characteristics, to analyze various scenarios

1.5 Methodology for calculating the Combined Drought Index

1.5.1 Calculation of the Precipitation, the Temperature and the Soil Moisture/Vegetation Drought Indices (PDI, TDI and MDI/VDI)

In the present approach, drought is conceived as a combination of:

- a precipitation component which considers (1) rainfall deficits and (2) persistence of dryness;
- a temperature component which considers (3) temperature excesses and (4) persistence of high temperatures;
- a soil moisture component which considers (5) soil moisture deficits and (6) persistence of dry soil conditions – because of limitations in soil moisture observations this is approximated by NDVI deficits and deficit persistence.

Based on the above, in step No.1 three individual drought indices are calculated:

- the Precipitation Drought Index (PDI)
- the Temperature Drought Index (TDI) and
- the Vegetation Drought Index (VDI), as a substitute for the Soil Moisture Drought Index

In step No.2 the Combined Drought Index (CDI) is computed, which integrates the above three indices.

The Equations for calculating the Precipitation Drought Index (PDI), the Vegetation Drought Index (VDI) and the Temperature Drought Index (TDI) for year i and time unit (dekad/month) m are given in Equations (1) to (3).

$$PDI_{i,m} = \frac{\frac{1}{IP} \sum_{j=0}^{IP-1} P_{i,(m-j)}^*}{\frac{1}{(n * IP)} \sum_{k=1}^n \left[\sum_{j=0}^{IP-1} P_{(m-j),k}^* \right]} * \sqrt{\frac{RL_{m,i}^{(P^*)}}{\frac{1}{n} \sum_{k=1}^n RL_{m,k}^{(P^*)}}} \quad (1)$$

$$VDI_{i,m} = \frac{\frac{1}{IP} \sum_{j=0}^{IP-1} NDVI_{i,(m-j)}^*}{\frac{1}{(n * IP)} \sum_{k=1}^n \left[\sum_{j=0}^{IP-1} NDVI_{(m-j),k}^* \right]} * \sqrt{\frac{RL_{m,i}^{(NDVI^*)}}{\frac{1}{n} \sum_{k=1}^n RL_{m,k}^{(NDVI^*)}}} \quad (2)$$

$$TDI_{i,m} = \frac{\frac{1}{IP} \sum_{j=0}^{IP-1} [T_{i,(m-j)}^*]}{\frac{1}{(n * IP)} \sum_{k=1}^n \left[\sum_{j=0}^{IP-1} T_{(m-j),k}^* \right]} * \sqrt{\frac{RL_{m,i}^{(T^*)}}{\frac{1}{n} \sum_{k=1}^n RL_{m,k}^{(T^*)}}} \quad (3)$$

where:

- P^* is the modified monthly or 10-day precipitation amount,
- T^* modified monthly or 10-day average temperature,
- $NDVI^*$ modified monthly or 10-day average Normalized Difference Vegetation index
- IP interest period (e.g. 3, 4, 5 ... dekads or months),
- $RL(P)$ (run-length) is maximum number of successive dekads or months below long term average rainfall in the interest period,
- $RL(T)$ maximum number of successive dekads or months above long term average temperature,
- $RL(NDVI)$ maximum number of successive dekads or months below long term average NDVI in the IP ,
- n number of years with relevant data,
- j summation running parameter covering the IP , and
- k summation parameter covering the years where relevant data are available.

The calculation of the index in simple words can be expressed as

$$\text{Drought Index} = \frac{\text{Actual average for IP}}{\text{LTM for IP}} * \sqrt{\left(\frac{\text{Actual length of continuous deficit/excess in the IP}}{\text{LTM length of continuous deficit/excess in the IP}} \right)} \quad (4)$$

where:

IP is the interest period,

LTM is the long term average and

deficit applies to rainfall and NDVI, and excess applies to temperature.

The actual drought index represents the severity of drought for the interest period ending in time unit m. For example, if the IP = 3 months, then the Combined Drought Index of 0.45 for June 2006 implies severe drought for April, May and June 2006.

Note that Equations (1), (2), and (3) use modified temperature, modified NDVI and modified rainfall data. Although in many cases the original data series would work well, for calculation and input standardization purposes it is recommended to use the modified observation series. One of the purposes of the modification is to avoid dividing by zero in certain cases, which could happen e.g. with rainfall mostly in countries with a distinct, long dry season. The other purpose is to have similar ranges of drought index values. A simple example of this is that the TDI would fluctuate within a different range of values if temperature is measured in Fahrenheit or Celsius degrees, although the physical content remains the same. Similar considerations apply to NDVI. The modification is done simply by shifting the x coordinate axis to convenient values as below. This modification only serves calculation purposes; it does not change the nature of the data series or that of the results in any way.

$$T^* = (T_{\max} + 1) - T$$

$$RL^* = (RL_{\max} + 1) - RL$$

(5)

$$NDVI^* = NDVI - (NDVI_{\min} - 0.01)$$

$$P^* = P + 1$$

where P, T and NDVI are the original precipitation, temperature and NDVI values and RL is the original run-length.

1.5.2 Calculation of the Combined Drought Index (CDI)

The combined drought index is computed as the weighted average of the precipitation, the temperature and the soil moisture drought indices. As soil moisture observation data are usually not easily accessible in adequate density, the values of the soil moisture drought index are approximated by the vegetation drought index

$$CDI_{i,m} = w_{PDI} * PDI_{i,m} + w_{TDI} * TDI_{i,m} + w_{VDI} * VDI_{i,m} \quad (6)$$

where w is the weight of the individual drought index.

The weights can be chosen according to various application environments, geographic locations and climate conditions. As a starting set of values it is recommended to use 50% weight for PDI and 25-25% weight for TDI and VDI. Where either temperature or NDVI data are missing, the precipitation index is assigned a weight of 67% and the other is assigned 33%.

Equation (6) is the general expression of calculating the CDI and it is used with monthly or longer observation units. It can also be used with Soil Moisture Drought Index on any time unit. When using VDI with dekadal time units, Equation (6) can be modified to reflect the fact that in general, the present day rainfall or soil moisture in a given area is likely to affect the vegetation of the area in about two dekads time. In that case Eq. (6) takes the form below

$$CDI_{i,m} = w_{PDI} * PDI_{i,m} + w_{TDI} * TDI_{i,m} + w_{VDI} * VDI_{i,m+2} \quad (7)$$

The above approximation is fairly easily applicable in historical analysis/simulation of previous events. In real time monitoring, because the VDI for time unit $m+2$ is not known yet, it is assumed that the present NDVI values are acceptable approximations for the present soil moisture conditions. As the latter is only approximation, in the future efforts should be made to use soil moisture observation data.

It is important to note that the CDI does not measure physical parameters of either vegetation or soil and it does not attempt to simulate either the physical phenomena or the water balance. It is a statistical index that measures how much the present conditions deviate from the reference level, which is the multi-year, long-term average for the interest period.

It is also worth noting that VDI is only a proxy for the Soil Moisture Drought Index. Besides the fact that changes in vegetation conditions depend on other factors apart from soil moisture, it is known that vegetation reaction to rain is delayed often by one week or two. This can be factored in when doing historical analysis, however in real-time monitoring the present soil moisture conditions would be reflected in vegetation conditions one or two weeks later, which is not known at the present time. Therefore in the course of future developments efforts should be made to use observed soil moisture values and calculate the Soil Moisture Drought Index instead of the VDI. In analysis with monthly time units calculating VDI does not present the above problem.

1.6 How to interpret CDI values

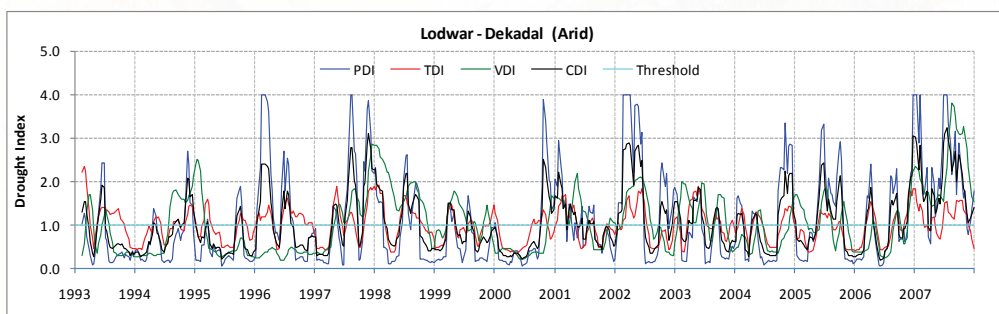
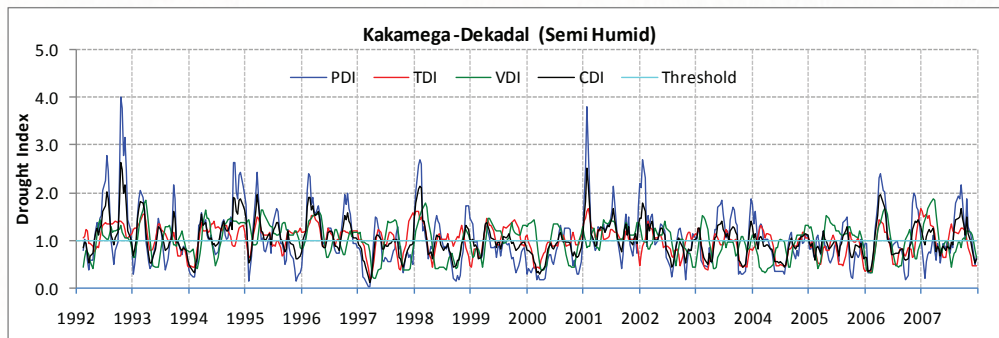
By definition of Equation (6), $CDI=1.0$ represents average weather conditions. If the CDI is greater than 1.0, it represents wetter than average, if it is below 1.0 it represents dryer than average conditions. Further research might be done to fit drought severity categories to geographic locations or plant types. As an initial categorization, for the Horn of Africa the following categories were developed:

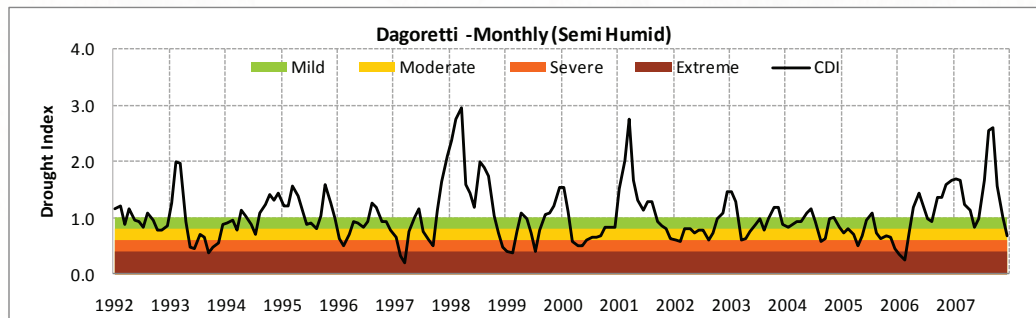
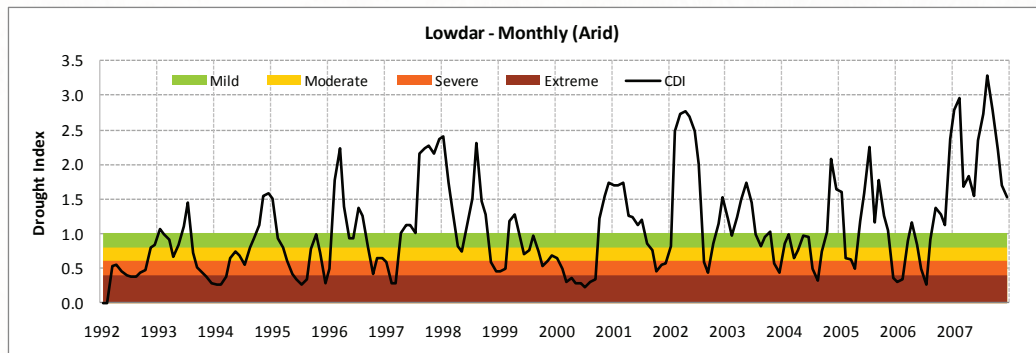
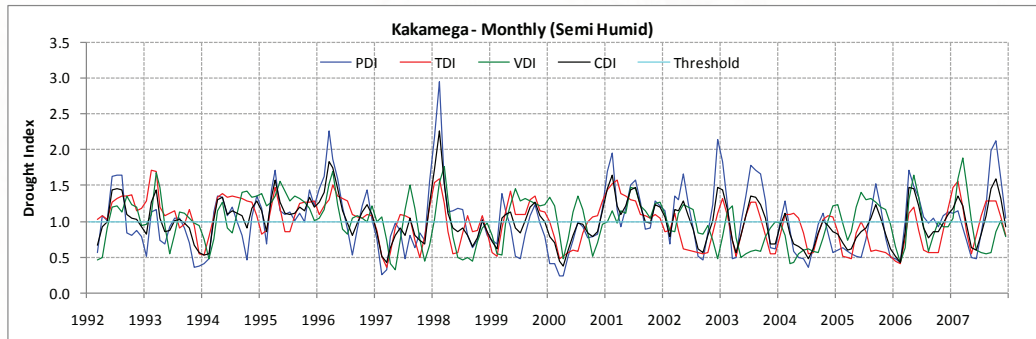
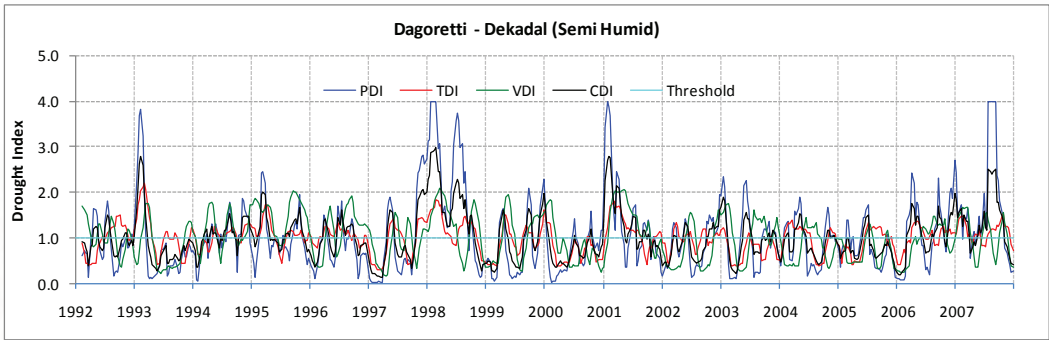
<u>CDI value</u>	<u>Drought severity</u>
>1.0	No drought
1.0 – 0.8	Mild
0.8 – 0.6	Moderate
0.6 – 0.4	Severe
<0.4	Extreme

1.7 Practical examples for CDI calculations

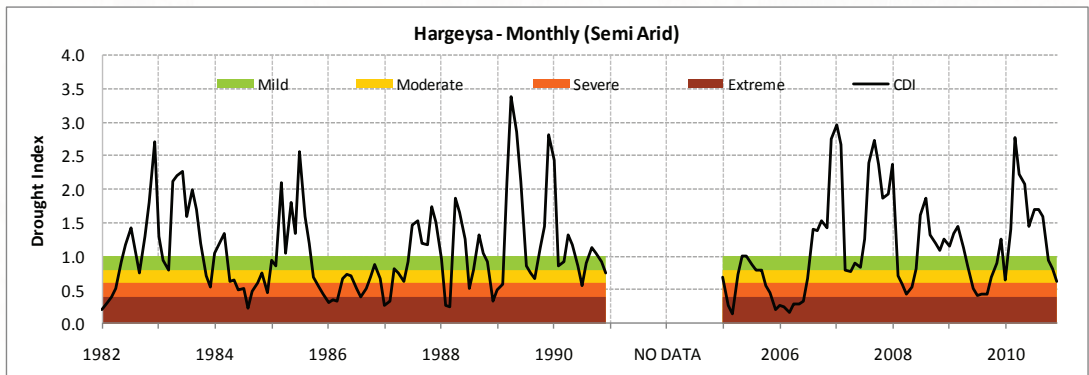
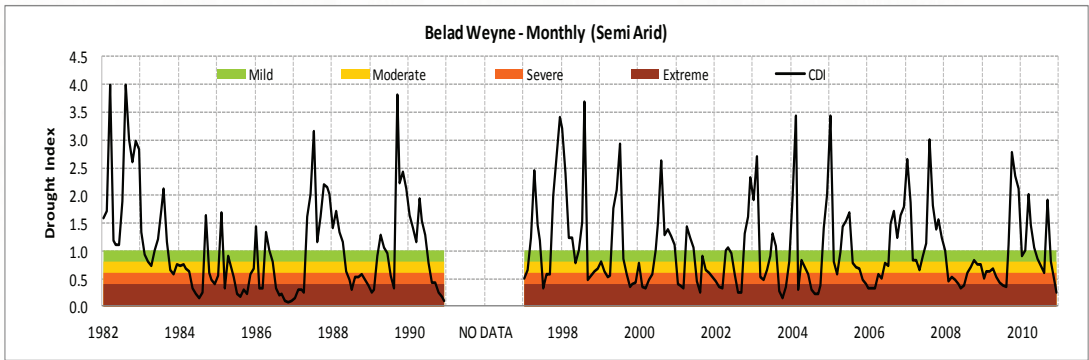
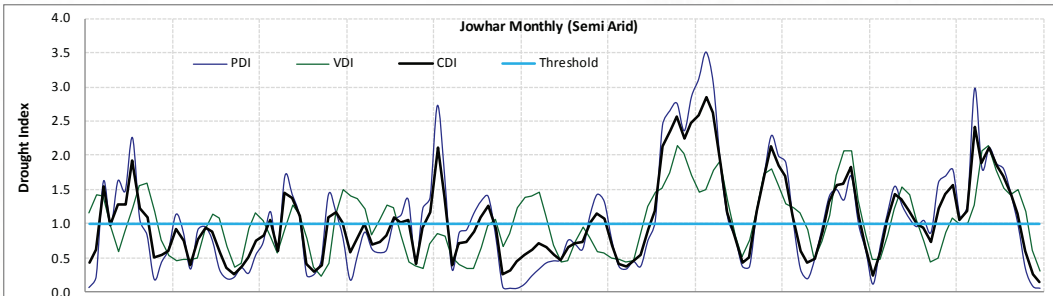
CDI time series were calculated for several stations in Kenya and Somalia, falling under different climatic regions. Some examples for dekadal (10-day) time units and some for monthly time units are as below.

1.7.1 Results for Kenya





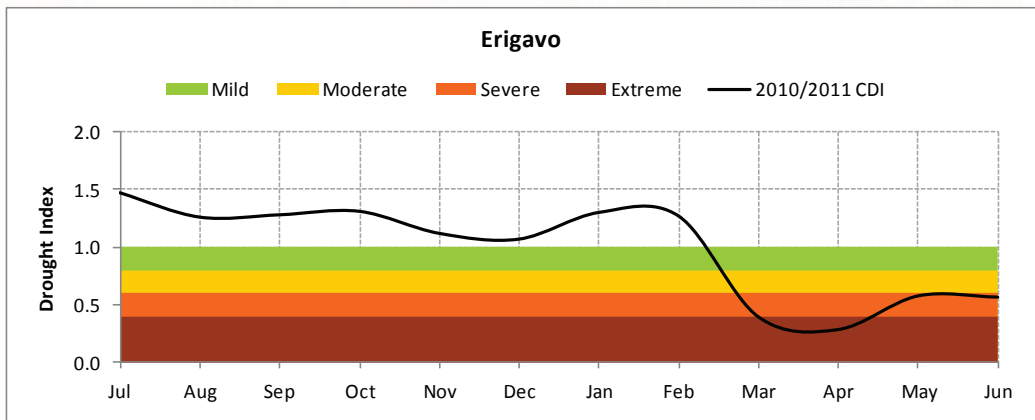
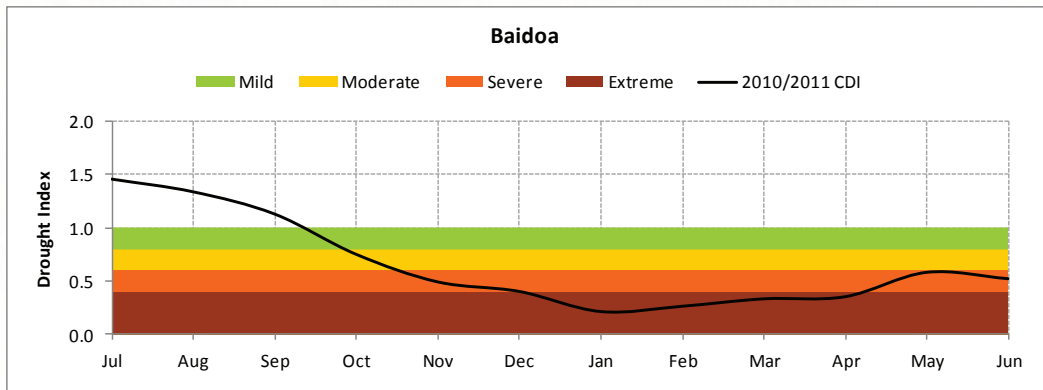
1.7.2 Results for Somalia (Note the gap in the longer-term Belad Weyne & Hargeysa observations)

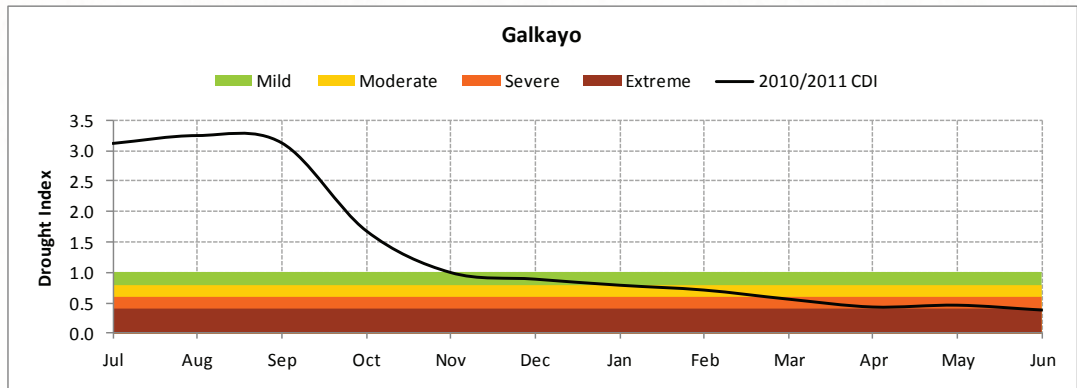
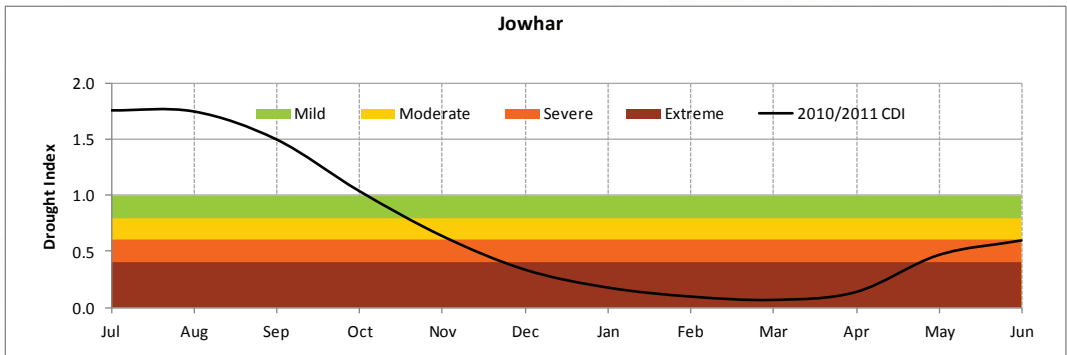


1.7.3 Results for the 2011 drought in Somalia

For different drought events different interest periods are suggested to use. A short, intensive drought is best characterized by the decadal calculation. Seasonal or longer droughts rather require for example a 6-month IP. For selecting the most suitable interest period either qualified expert assessment is needed or several calculations can be run by the software on the attached CD, the run-time of which is very short.

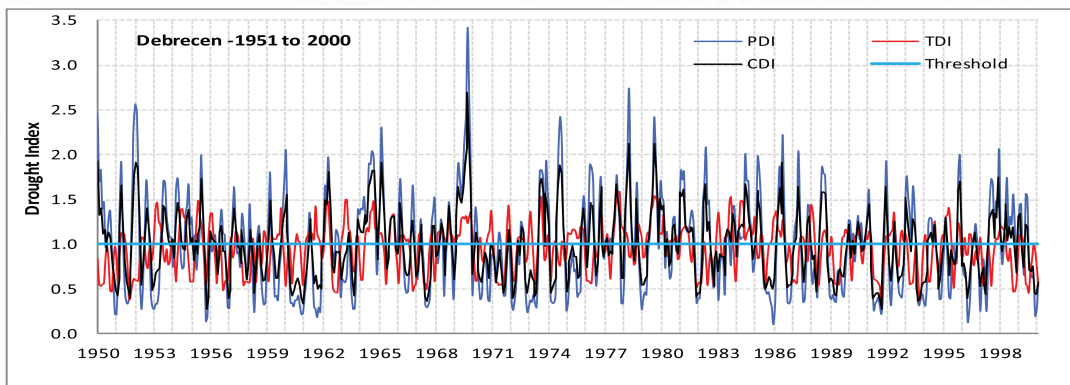
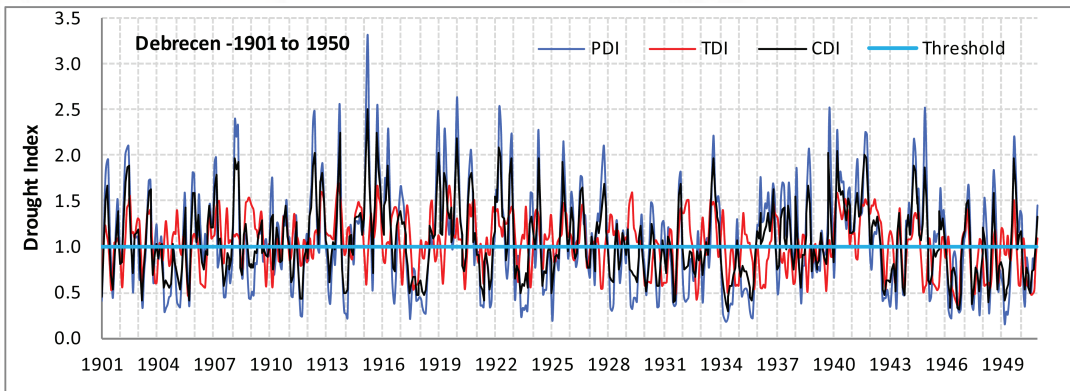
The 2011 Somali drought could be best monitored by a 6-month IP. This is because the drought actually started in 2010, when after a very good March-May rainy season the October-November rainy season completely failed. This was followed by another failure of the rains in March-May 2011. In May some stations measured quite good amount of rain, but that was already too late and too short for the crops to produce any harvest. The 6-month CDI shows clearly the cumulative effect of the two failed rainy seasons and that of the late rains in May 2011.





1.7.4 Results for stations outside Africa

Calculations were done for 2 stations in Hungary, Debrecen and Szeged with 100-year long time series, to test the performance under temperate continental climate conditions. The results not only confirm the usability of CDI under those conditions, but also indicate the possibility of using it as part of further climate variability studies. See the results for Debrecen below.



1.8 Comparison of CDI values with official drought records

As natural droughts are experienced through their impacts on agriculture and livelihood of the population, historical drought events are quite well documented in official drought records in Kenya, although spatial and temporal accuracy of the records is not very good. It is sometimes not accurately recorded which part of the country experienced the drought in which months; the records only state the year. It is also very difficult to get accurate figures on production loss, food import and distribution and other drought related socio-economic indicators. The presidential drought declarations however, indicate clearly which years experienced the severest droughts. From among these years 1994, 1997, 2000 and 2006 were chosen for which the official drought records were compared with the CDI calculations with very good results of coincidence.

The results of the CDI calculations for the most critical year, 2000 are shown below. The CDI values show both the temporal evolution of the drought and its spatial distribution in the most affected areas.

Drought in Kenya in 2000 - CDI values by station, by month								
Year	Month	Kakamega	Kisumu	Lodwar	Embu	Dagoretti	Wajir	Mandera
		Kenya	Kenya	Kenya	Kenya	Kenya	Kenya	Kenya
		West	West	North	Central	Central	East	East
1999	10	1.32	1	0.6	0.46	1.05	0.88	0.9
1999	11	1.08	0.9	0.69	0.81	1.21	0.65	0.78
1999	12	0.96	1.04	0.79	1.07	1.57	0.74	0.86
2000	1	0.77	1.06	0.71	1.37	1.47	0.9	1.06
2000	2	0.67	0.87	0.59	1.31	1.06	0.96	1.02
2000	3	0.42	0.68	0.42	0.64	0.58	0.63	0.61
2000	4	0.34	0.51	0.46	0.49	0.52	0.5	0.62
2000	5	0.49	0.49	0.33	0.31	0.51	0.34	0.89
2000	6	0.63	0.61	0.31	0.32	0.62	0.33	0.99
2000	7	0.75	0.82	0.25	0.34	0.67	0.45	1.53
2000	8	0.7	0.93	0.31	0.53	0.65	0.63	0.56
2000	9	0.6	0.95	0.36	0.65	0.66	1.22	0.42
2000	10	0.71	0.93	1.25	0.52	0.8	0.76	1.05
2000	11	0.86	1.12	1.77	0.48	0.72	0.53	1.09
2000	12	1.07	1.34	1.91	0.42	0.73	0.32	0.83
2001	1	1.33	1.91	1.55	0.68	1.42	0.34	0.45
2001	2	1.53	1.86	1.65	1.03	1.88	0.5	0.43
2001	3	1.14	1.3	1.7	1.34	2.57	0.85	0.61

Drought severity legend					
category	no drought	mild	Moderate	severe	extreme
colour code					
CDI	>1.0	1.0 - 0.8	0.8 - 0.4	0.6 - 0.4	<0.4



A photograph of a dry, eroded landscape. The foreground shows a dirt path leading through a series of shallow, eroded gullies. The soil is light brown and appears to be composed of soft, erodible material. In the background, there are several trees, some with green foliage and others that are bare and skeletal. The sky is overcast and grey. The overall scene suggests a semi-arid or arid environment with significant soil erosion.

Part 2

CDI Calculator User Manual

2.1 General features of the software

CDI is a Microsoft Excel-based software package that provides an easy-to-use means of calculating indices for monitoring drought. It was developed by FAO SWALIM (Food and Agriculture Organization – Somalia Water and Land Information Management) and has been tested using data from Kenyan, Somali and Hungarian weather stations.

The CDI (1.1) computation software is free and runs in Windows© operating system. It is designed to automate the computation of drought monitoring indices. The software computes four indices; Precipitation Drought Index (PDI), Temperature Drought Index (TDI), Vegetation Drought Index (VDI) and Combined Drought Index (CDI). The CDI is computed as a combination of the PDI, TDI and VDI. All the indices that are computed by the software are in defined time periods, either in dekadal (10 days) or monthly.

The CDI computation software contains 4 modules:

- (i) Import data
- (ii) Calculate index
- (iii) Modify data
- (iv) Manage stations

The key modules of the software are Import data and Calculate index. Import data allows the user to import data into the application database in a pre-defined format. The Calculate index module, as the name suggests, calculates the drought indices from the imported data. The other two modules are for administration of the database, for example to modify data and to add or delete stations.

2.2 Installation and running of CDI (1.1)

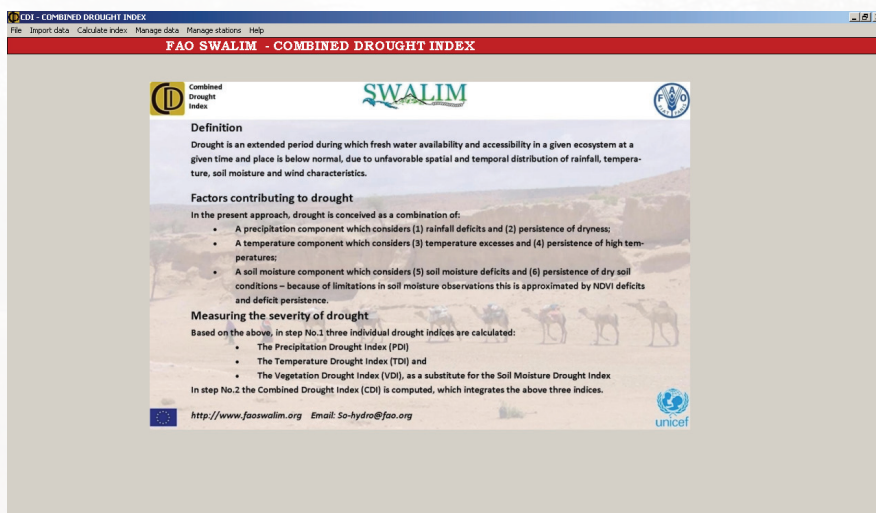
2.2.1 Installation

The CDI software is windows based and is distributed in a CD Rom. To install the software, it is required that the computer operating system be a Windows98 or higher version. The CD auto-runs when loaded to the computer, opening the installation wizard. If the CD does not auto-run upon loading, then the installation wizard can be activated by exploring the contents of the CD and double clicking on the file CDI.msi file. The wizard goes through a step-by-step installation process, and copies the application user resources to the respective folders.

Once the installation is complete, a dialog box is displayed indicating that the installation has been completed successfully. The system installs in C:\Program Files\FAO SWALIM by default. A shortcut of the software is placed on the desktop on successful completion of the installation process.

2.2.2 System startup process

You can start the System either by clicking on the CDI shortcut on the desktop, or selecting Start -> Programs -> FAO SWALIM -> CDI. The CDI Splash Screen will show briefly and then the main user interface will be displayed. The user can perform different tasks by selecting the appropriate menu item from the main menu bar.



2.2.3 Input data format

The input data file should be in excel format. The monthly or dekadal time series data are stored in single files for each station. The station file contains a table each for rainfall, temperature and vegetation data, one below the other, separated by one or more empty rows, as shown in the figure below. The tables can be in any order, and the first table must start in cell A1. Each table contains two headers, the first being the station name and immediately below it, the data type (temperature, vegetation or rainfall). The headers must be placed in the second column. The third row of the first column shows the year/time series (month or dekad). Careful attention should be paid to spelling of station names for all tables and the spelling of the parameters, as these are used for identification of the records. Missing records should be left blank.

Data input templates are located in the software installation path in the folder 'templates'. The user can copy and paste data from other excel file sources in the respective data type by using the option 'Insert copied cells' so that the copied data is inserted correctly.

Station	Test_station3											
Data Type	Rainfall											
YEAR / MONTH	1	2	3	4	5	6	7	8	9	10	11	12
1986	13.5	2.0	83.1	243.1	264.1	32.2	8.1	11.7	9.2	38.5	203.5	132.8
1987	45.5	13.8	53.7	331.5	99.3	81.7	8.0	18.0	24.1	11.5	168.4	44.1
1988	77.0	27.3	135.3	392.5	246.8	96.6	20.6	38.0	23.8	35.5	93.9	157.8
1989	111.2	49.4	83.2	268.7	262.8	34.3	44.9	31.6	61.4	70.4	125.9	216.6
1990	53.7	29.6	218.8	251.5	168.3	15.7	22.7	16.6	33.8	77.0	151.0	104.9
.
.
Station	Test_station3											
Data Type	Temperature											
YEAR / MONTH	1	2	3	4	5	6	7	8	9	10	11	12
1986	25.76	28.01	26.22	23.65	22.11	20.82	21.51	23.41	23.93	26.00	23.05	23.34
1987	25.07	26.49	26.15	24.43	23.19	22.12	21.36	22.16	24.43	25.05	23.27	23.78
1988	25.07	26.49	26.15	24.43	23.19	22.12	21.36	22.16	24.43	25.05	23.27	23.78
1989	25.07	26.49	26.15	24.43	23.19	22.12	21.36	22.16	24.43	25.05	23.27	23.78
1990	25.07	26.49	26.15	24.43	23.19	22.12	21.36	22.16	24.43	25.05	23.27	23.78
.
.
Station	Test_station3											
Data Type	Vegetation											
YEAR / MONTH	1	2	3	4	5	6	7	8	9	10	11	12
1986	0.29	0.29	0.13	0.19	0.44	0.55	0.47	0.33	0.26	0.23	0.35	0.54
1987	0.53	0.38	0.27	0.37	0.54	0.45	0.50	0.31	0.25	0.15	0.27	0.51
1988	0.37	0.41	0.31	0.44	0.50	0.58	0.37	0.27	0.11	0.24	0.28	0.35
1989	0.46	0.55	0.36	0.37	0.45	0.55	0.36	0.11	0.23	0.39	0.35	0.46
1990	0.58	0.37	0.41	0.41	0.52	0.41	0.32	0.16	0.28	0.22	0.47	0.58
.
.

2.2.4 Import data

The first step is to import data into the application's database. The data files must be saved in Microsoft excel and in the specified format as explained in section 2.2.3. Data input format is similar for both dekadal and monthly computations; the dekadal however has more columns because there are 36 dekads while there are 12 months in a year.

To import data, click on 'Import data' from the main menu then choose dekad or monthly. The data import dialogue box shown below is displayed.

Click on 'Browse' to locate the data file. Browse to the location where your data files are stored. Sample data are located in a sample data folder within the root folder where the CDI is installed. The user can load only one file at a time. Select the file to be uploaded to the application database and click on open. To complete the data import process, the user needs to click on 'Load and Save Data' button. This starts the data extraction and on completion prompts the user to choose whether to proceed to index calculation.

The software enables the user to set thresholds for each parameter. This means that data outside the threshold range will be recorded as an error. The error log provides the user with the specific cells that are outside the threshold range. This step is, however, optional, and can be ignored, especially if the data has gone through prior quality control.

2.2.5 Deleting data

From the import data screen, the user is able to purge unwanted data from the application by deleting a station of choice. All data import instances are assigned a unique batch number. It is this batch number that is used for deletion. Selecting a batch number displays the station associated with it, and clicking on 'Delete Permanently' will delete the data for that station. All data imported with this batch number will be deleted. It should be noted that the data is deleted only from the application database, and not from the original source file.

2.3 Index calculation

The 'Index Calculation' window allows the user to select the station, enter the start and end years for the index calculation and the indices to compute. Other parameters that have to be defined from this window include the Time Unit, the Interest Period (IP) and the Weights defined in 1.5.1 and 1.5.2 (CDI Methodology). Depending on the area under investigation, the IPs are different. If the user does not have all the data for the three parameters then one does not need to calculate all the three indices. For example, if the user has only rainfall and temperature data, then only the PDI and TDI will be computed and CDI is computed using the available two. However, it must be noted that the CDI cannot be computed without rainfall data.

After selecting the station, period, defining the IP and weights, the user then clicks on 'Calculate Index' which initiates the calculation of the indices. The process may take a few minutes depending on the time period under investigation.

The software allows the user to run the index calculation process as many times as desired using various criteria. The results are produced in a separate Excel sheet and are not saved until the user decides to do so. On the Excel sheet, two graphs are displayed together with the output values of the indices; one graph shows all the indices and the other shows only the CDI overlaid on color code that depicts drought situations. For ease of visualisation, index values greater than 4 are not shown in the graphs and the current methodology characterises drought values between 0 and 1.

INDEX CALCULATION DEKADAL (10-day)

STATIONS IN THE SELECTED COUNTRY

TIME UNIT: DEKAD

INTEREST PERIOD: 5

YEAR FROM: []

MONTH & DEKAD: Jan 1

YEAR TO: []

MONTH & DEKAD: Dec 3

PARAMETERS:

- PDI
- VDI
- CDI

WEIGHT:

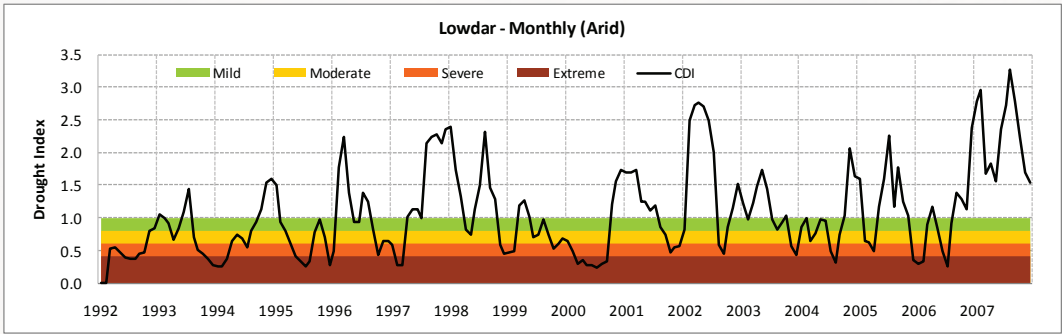
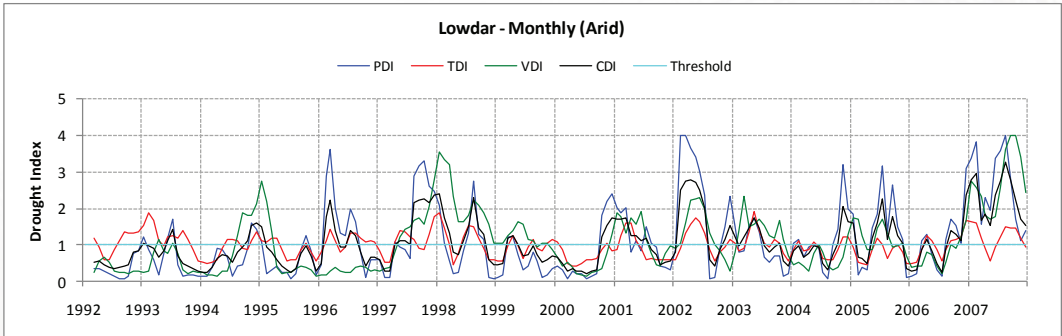
- PDI: 0.5
- VDI: 0.25
- CDI: 0.25

Data file: [] **Open**

SWALIM

CALCULATE INDEX **SHOW EXCEL** **EXIT**

PDI		VDI		TDI		CDI/RESULTS																	
CDI																							
YEAR	DK1	DK2..	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	



2.4 Manage data

The 'Manage Data' module is used to amend the imported data if need be. The user can change a record within the application database. The steps to modify data are explained below.

Dekad	Year	VALUE

Steps:

- 1 Select the data type i.e. Dekad or Monthly
- 2 Select parameter i.e. Temperature, Rainfall or Vegetation
- 3 Select the station from the dropdown list
- 4 Enter the year, then click on the 'Go' button
- 5 Select an item in the list view to amend
- 6 Amend the value as necessary and click on the update button

2.5 Manage stations

This module can be used to add new stations although the stations are added automatically during the data import step. In addition, the user is also able to make changes to the station details.

COUNTRY NAME

STATION NAME

Select or add new country by typing the country name in the provided text box and clicking on 'Save'. You can also update country names by selecting the country and clicking on 'Update' below the country name text box.

The next thing is to enter the station for the selected country. Type the station name and click on 'Save'. To Edit a station, select the station name, make a correction and click on 'Update'.

Resources

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